

REMARKS

1. Claim 1 has been amended to recite “a supported highly selective epoxidation catalyst comprising silver . . . and further comprising rhenium or compound thereof” based on page 8, lines 17-26 of the application text as filed and to recite “for a duration of at least 1 hour and up to 150 hours” based on page 11, lines 14-17 of the application text as filed. Claims 4 and 20 have been amended with the intention of improving the claim language in light of the amendments to claim 1. Claim 26 has also been amended similarly to claim 1.

2. Claims 1-9 and 11-25 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hayden et al (U.S. Patent No. 4,007,135 (hereinafter “the ‘135 reference”)). This rejection is respectfully traversed. Applicants claimed method in the present application relates to a supported highly selective epoxidation catalyst comprising silver in a quantity of at most 0.17 g per m² surface area of the support and further comprising rhenium or compound thereof. The catalyst, or a precursor of the catalyst containing silver in cationic form, is contacted with a feed comprising oxygen at a catalyst temperature above 250 °C for a duration of at least 1 hour and up to 150 hours, and subsequently the catalyst temperature is decreased to a value of at most 250 °C.

As explained in the application text, as filed (page 3, line 19 – page 4, line 8), the present invention provides a heat-treating method specifically applicable to epoxidation catalysts having a selectivity enhancing dopant of rhenium and having a relatively low silver density. **It has been found that the selectivity of the defined highly selective epoxidation catalyst can be improved by heat-treating the catalyst for an extended period of time in the presence of oxygen at a temperature which is typically above the catalyst’s normal initial operation temperature.**

The ‘135 reference discloses many possible promoters. For example, possible promoters include: copper, gold, zinc, cadmium, mercury, niobium, tantalum, molybdenum, tungsten, vanadium, or preferably chromium, calcium, magnesium, strontium and/or, more preferably barium. *U.S. Patent No. 4,007,135*, col. 1, ll. 35-39. Additional promoters include: alkali metals, especially sodium, potassium or rubidium. *Id.* at col. 3, ll. 13-17. The ‘135 reference also discloses heating the silver-containing catalyst precursor to a temperature of 200-400 °C. *Id.* at col. 5, ll. 17-20. The ‘135 reference states that the purpose of heating of the silver-containing catalyst precursor is to decompose the silver compound

into silver metal. *Id.* at col. 4, ll. 11-23. There are no generic teachings in the '135 reference with respect to heating atmospheres or heating times. In the examples of the '135 reference, use of atmospheres of hydrogen and air to decompose/reduce the silver catalyst precursor to silver metal were specifically disclosed. When decomposing the silver catalyst precursor in the examples, the precursor catalysts were heated for 1 hour while heating at 220 °C or for 4 hours while either heating from 100 to 280 °C or 100 to 300 °C at 0.8 °C/min.

The '135 reference does not disclose or suggest the use of rhenium as a promoter. Further, the '135 reference does not teach or suggest heating the catalyst precursor for a period of time greater than required to decompose/reduce the silver precursor to silver metal. As shown in the working examples of the present application text as filed, it is surprising that heat-treating a catalyst, as defined in the claims, in the presence of oxygen for an extended period of time (beyond that required to decompose the silver precursor into silver metal) would result in an improvement in the performance of the catalyst, in particular the selectivity.

Examples 5-12 of the application text, as filed, demonstrate that after exposing a catalyst, as defined in the claims, (and which has already been heated at 250 °C for 5.5 minutes in air to decompose the silver precursor to silver metal) to an oxygen-containing feed stream at a high temperature, for example 260 °C, for an extended period of time, for example 4 to 24 hours, **the catalyst unexpectedly exhibits an improvement in selectivity** when it is subsequently used during normal operation in an epoxidation process. In particular, an improvement in selectivity was observed of 5.0 to 6.5 %-mole over the same catalyst that was not subjected to the heat-treatment (See Table A below).

Table A

Example	Duration (h) at 260 °C	Catalyst Temperature (°C)	Selectivity (%-mole)	Change in Selectivity relative to the base case with no heat treatment
5	0	226	83.5	---
6	4	237	88.8	5.3
7	12	245	89.4	5.9
8	24	252	89.8	6.3
9	0	230	83.0	---
10	4	237	88.0	5.0
11	12	247	89.5	6.5
12	24	242	89.5	6.5

These improvements in selectivity are completely unexpected in light of the '135 reference which does not disclose rhenium as a promoter and does not provide any reason to heat the catalyst precursor beyond a period of time for decomposing/reducing the silver component to silver metal. In view of these arguments, Applicants believe that claims 1-9 and 11-25 are non-obvious over the '135 reference. Applicants respectfully request that the rejection be withdrawn.

CONCLUSION

Applicants respectfully request that the Examiner reconsider the present rejection in the light of the arguments presented in these remarks.

Allowance of the claims of the present application is respectfully requested. Should any fee be due in connection with the filing of this document, the Commissioner for Patents is hereby authorized to deduct said fee from Shell Oil Company, Deposit Account No. 19-1800. If the Examiner would like to discuss this case with Applicant's attorney, the Examiner is invited to contact Lisa Holthus at the phone number below.

Respectfully submitted,

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